



REPORT

on the application for the opened academic position "Associate Professor" in the professional field 4.1. Physical Sciences (Electrical, Magnetic, and Optical Properties of Condensed Matter) in the Faculty of Physics at the Sofia University "St. Kliment Ohridski", announced in State Gazette No 93 on 26.11.2019, with a candidate Assistant Professor Kiril Mladenov Kirilov

from Prof. D.Sc. Victor Genchev Ivanov, Faculty of Physics at the Sofia University "St. Kliment Ohridski

Overall presentation of the applicant

Kiril Kirilov graduated in 2001 with a master's degree in a five-year program, with a major in Engineering Physics and a specialization in Microelectronics and Information Technology at the Faculty of Physics of Sofia University "St. Kliment Ohridski ". The average grade from the semester exams is 4.56, and from the defense of a master's thesis – Excellent 6.00. From 2003 to 2006 the candidate was a full-time doctoral student at the Faculty of Physics with a thesis director Assoc. Prof. Krasimira Germanova. In 2008 he successfully defended his thesis on "Characterization of bulk semiconductor and nanostructured materials with surface photovoltaic spectroscopy" for the acquisition of the Doctor degree with a scientific code 01.03.26 (Electrical, magnetic and optical properties of condensed matter).

The applicant's career began in 2006 as a physicist in the Laboratory of Electronic and Phononic Properties of Solid State Materials and Structures at FTTME department of the Faculty of Physics. In 2012, Kiril Kirilov obtains a position of Senior Assistant Professor at the same department (now at the FKMME joint department), where he conducts laboratory exercises and lectures in a number of courses taught by the department.

The applicant's research activity corresponds to the scientific subject of the opened position and can be divided into two main areas: (1) experimental studies of new materials with potential applications in microelectronics and (2) new research methods for characterization of materials and models for analysis of experimental data. One of the applicant's works is of educational character and can be defined as developing of new teaching methods in the high school.

Scientific metrics and compliance with the requirements of the ZRASRB and the Faculty of Physics of Sofia University

The applicant has submitted a list of 29 publications in scientific journals and 10 full-text scientific conference reports. Of these, 25 publications are in Impact Factor or Impact Rank journals, 19 are in Q1 or Q2 quartiles and the remaining 6 are in Q3 or Q4 quartiles journals. A list of 89 independent citations has been presented, but an up-to-date reference in SCOPUS indicates that their actual number is almost twice as high as 160, with a Hirsch index of 5.

From all publications the candidate has chosen to participate in the competition with 16 articles that do not repeat the works included in his doctoral dissertation. Four of these articles (1) – (4), published in the journals of Quartile Q1, are distinguished as equivalent to "habilitation work". They earn the applicant 100 points according to the relevant group of indicators B in the minimum national requirements set out in the Annex to the ZRASRB. The remaining 12 publications are included in group D (non-habilitation works) and earn a total of 212 points with a minimum requirement of 200 points. The applicant has also submitted the corresponding citations of the works, equivalent to 50 points in indicator E (citations in scientific publications indexed in international databases). **On the basis of the above arguments, it is clear that the applicant fully complies with the minimum national requirements within set by the ZRASRB for the academic position of Associate Professor.**

At the time of the announcement of the competition, the deadline for submission of documents, and for the preparation of reviews, the Recommended Requirements of the Faculty of Physics for the academic positions and scientific degrees from 2012 had been still valid. By the way, this is still the document that it is on the webpage of the Faculty of Physics, although new requirements for the candidates have already been adopted by the AC of the Sofia University in the spirit of the Annex to the ZRASRB. Therefore, in Table 1, I present a comparison with the Recommended Requirements.

The comparison undoubtedly shows that the applicant covers, and by some criteria - significantly exceeds, the Recommended criteria of the Faculty of Physics for the occupation of the academic position "Associate Professor".

Table 1. Comparison of the individual scientific indicators and the teaching experience of the applicant with the Recommended requirements of the faculty of Physics.

Criterion	Recommended requirements	Applicant's indicator
Teaching experience	At least 2 years of full-time teaching	7 years of full time teaching
Academic tutoring of BSc or MSc diploma works, or a PhD thesis	yes	Tutoring of 4 diploma works – 3 BSc and 1 MSc
Number of publications: <ul style="list-style-type: none"> • total • in journals with IF or IR • as a first/corresponding author 	20 12 6	29 25 5
Independent citations	30	89 (160 according to Reviewer's query)
Hirsh index	5	5
Coordination or participation in national or international projects	yes	- Participant in 15 projects funded by the National Scientific Fund, among which 3 on bilateral international programs. - Participant in one international project funded by EC and one COST project. - Coordinator of one project funded by the Sofia University.

Analysis of the applicant's scientific contributions

Most of the candidate's works are related to the fabrication and characterization of new materials. The candidate's contribution to these works is mostly in the experimental characterization of thin layers and nanostructures by variety of techniques: Raman spectroscopy, photoluminescence and cathodoluminescence, optical transmission, conductivity, and voltammetric characteristics. The applicant also actively participates in the processing and interpretation of the results. In accordance with the requirements of the ZRASRB, I will consider publications (1) - (4), referred to by the applicant as habilitation work, as well as to the thematically related works.

Works (1) and (8) are devoted to the synthesis and characterization of carbon nanostructures – a modern and actively developing scientific field. In reference (1), thin carbon layers obtained by pulsed laser deposition have been investigated. The deposition conditions of a sp^2 hybridized carbon have been optimized. The measurements of the resistance of the layers, conducted by the candidate, are consistent with the results of Raman measurements and lead to the conclusion that nanoscale graphene deposition is observed. The paper (8) proposes a new

technology for the production of graphene oxide – two-dimensional polymerization. Different characterization methods have been used to prove the proposed concept. The contribution of the candidate to this work is related to performing experiments on the cathodoluminescence of the layers obtained and a theoretical interpretation of the results.

Works (2), (4), (7), (10), (12), (14) and (15) are related to studies of nitride materials and nanostructures, which have significant potential in modern photovoltaic applications. From this point of view, the authors have correctly focused on optical methods for study of these materials, and the applicant has made a significant contribution to the Raman and photoluminescent measurements. Raman spectroscopy, for example, has been used to monitor the internal stresses in epitaxial layers of InN on a GaN substrate under various technological conditions (work 4). At the same time, photoluminescence spectra allow to determine the width of the band gap in the studied layers. Thus, an important correlation has been found between the internal stresses in the layers and their electrical and optical properties. A similar type of combined studies – Raman and photoluminescent, with a significant contribution from the candidate, are given in (2). A pronounced correlation between the crystal lattice defects, as characterized by the position of Raman-active vibrations, and the band gap in InGaAsN alloys has been established in that work. In the other papers in this group, the candidate also has made a significant contribution, both to the optical measurements and to the measurement of the specific resistance and the V-A characteristics of the studied nitride materials.

Of particular interest is the paper (3) published in Review of Scientific Instruments, in which the applicant is the leading author. This work has the character of a new technical solution. An original method for integrating of an optical fiber into vacuum systems is proposed, with a special adapter designed and tested for this purpose. The proposed method allows for various optical and spectral measurements under vacuum conditions, with the optical signal being transmitted via the fiber to an external spectrometer. The method was tested for the study of cathodoluminescence spectra in an Avantes scanning electron microscope, Avaspec-2048 TEC-2, which greatly expanded the functionality of the apparatus. I would say that this work best characterizes the candidate as a talented experimenter who, in addition to mastering a number of modern experimental techniques, is able to design specialized scientific equipment to solve specific problems.

In conclusion, after reading the works presented in the competition and the author's contribution report, I am convinced that the works are original in nature and any form of plagiarism should be excluded. It is also clear that the applicant has a significant or leading contribution to the presented works.

Teaching activity of the candidate

The main part of the applicant's teaching is related to a guidance of practical exercises in several different disciplines: Basic computer knowledge, Fundamentals of programming, Modern experimental methods, General physics, Physical electronics part 2, Specialized

workshop in physics of solid state and microelectronics. In addition to exercises, Kiril Kirilov has experience in lecturing, especially in the courses of Practical Physics and Experimental Methods in Solid State Physics. Due to the wide range of candidate-led courses, he taught to students from several different specialties of the Faculty of Physics - Physics, Engineering Physics, Communication and Physical Electronics, Physics and Informatics. **Therefore, I can confidently say that the candidate has sufficient teaching experience to hold the academic position of Assistant Professor.**

Candidate's activities in promoting physics to the publics

Working with high school students is a part of the Faculty of Physics' strategy of attracting applicants to various specialties of the faculty. In this respect, Kiril Kirilov works actively as a member of the National Commission for the Olympiad in Physics. For nine years he has authored experimental assignments for the final round of the Olympics – to select the enlarged National Team. This is a responsible and time-consuming task that is related both to the conceptual design of the experiment and to the assembly of the experimental setup as well. The educational experiments designed by the applicant are distinguished by their originality and are definitely of interest in the methodology of teaching physics. One of these experiments, a method for measuring the density of granular materials, was documented in a publication in the international journal *Physics Education* (Ref. 13). I would encourage the candidate to publish other of his educational experiments, among which I would point out a perfectly designed Michelson interferometer, a setup for determination of the Young's modulus by measuring the resonant frequencies of cylindrical rods, etc.

Critical remarks to the candidate

My main criticism is related to the compilation of author's report of scientific contributions. According to the latest changes in ZRASRB (item 12 of the Regulations for the implementation of the law), the corresponding document is referred to as "Habilitation Extended Reference for Scientific Contributions" and contains headings: "1. An introduction that briefly describes the nature of the scientific problems studied and their place among other researchers in the field; 2. Basic scientific contributions, in which the applicant describes in detail and in detail the specific original scientific contributions with which he / she applies for the competition; 3. A bibliography clearly distinguishing between the articles in which the candidate participates in the competition and other articles of the applicant and those of other authors."

In essence, the candidate provides the information required by ZRASRB, detailing the nature of the scientific problems and explicitly emphasizing his own contributions to the work, but using a different format. I attribute this to the lack of methodological guidance on the implementation of the latest amendments to the law, including the new format of the Habilitation Report. I would like to emphasize that my criticism is purely formal in nature and does not detract from the undisputed scientific contributions of the applicant.

Final conclusion

The facts outlined in the review show that the candidate is an established scientist who has the potential to lead a research group on solid state physics at the Faculty of Physics in the future. At the same time, he is an experienced physics lecturer and promoter. The applicant's formal scientific metrics indicators are above the average level of the applicants for the Associate Professor positions in the Faculty of Physics.

On this basis, I strongly recommend to the Faculty Council of the Faculty of Physics to recruit Dr. Kiril Kirilov for the academic position of Associated Professor in the professional field 4.1. Physical Sciences (Electrical, magnetic and optical properties of condensed matter).

Made in Sofia on 07 February 2020.

Reviewer:

/Prof. D.Sc. Victor Genchev Ivanov/